EXECUTIVE SUMMARY

The City of Lincoln, Nebraska (City) has completed final testing and data evaluation efforts relating to the Salt Creek Water Quality Studies (SCWQS), which began over 10 years ago. The purpose of the SCWQS is to develop site-specific chronic ammonia criteria for Segment LP2-20000 of Salt Creek based on extensive chemical, biological, and physical analysis. In June 1998, a Work Plan was developed that addressed final technical work to be completed on Salt Creek to more accurately characterize the complex interactions of ammonia in Salt Creek with the ultimate goal of developing a site-specific chronic ammonia criteria protective of the biological community. With technical input from the Water Environment Research Foundation (WERF) Peer Review Panel organized for the SCWQS project, the Work Plan was revised with final recommendations made in the June 21, 1999 Technical Addendum #1. The final technical items outlined in Technical Addendum #1 were completed in late 1999 and early 2000.

Combined results of Technical Addendum #1 modifications and historical SCWQS studies have been divided into six separate manuscripts, which follow this Executive Summary. A manuscript format was recommended by the WERF Peer Review Panel so that individual components of the study could be evaluated independently. The manuscripts describe the procedures followed, results obtained, and recommended site-specific criteria for Salt Creek Segment LP2-20000.

The following are Key Findings from each of the manuscripts, which highlight the main points and conclusions in each manuscript.

Manuscript 1 – Bio-assessment Work – The Response of Fish and Benthic Macroinvertebrates To Ammonia Toxicity in Salt Creek

- The toxicity of ammonia to the biological community in Salt Creek was measured by observing decreases in the number of fish species, the number of minnow species, the number of benthic macroinvertebrate taxa, and the number of fly taxa at sampling sites located downstream from the Theresa Street and Northeast Wastewater Treatment Plants (WWTP's).

- There is a summer dose-response relationship between the number of fish species and the number of minnow species at site BSS04 downstream from the Theresa St. WWTP and at site BSS08, downstream from the Northeast WWTP, and ammonia. This relationship shows that the number of species decrease as ammonia concentrations increase

- There was no winter dose response relationship between the number of fish species and the number of minnow species below the Theresa Street and Northeast WWTP's and ammonia.

- Life cycles of the 36 species of fish collected from Salt Creek demonstrate that Early Life Stages are absent from Salt Creek during the time period of October 20 through March 20.

- There is not a relationship between the benthic macroinvertebrate metrics and ammonia in Salt Creek. The USEPA presented data in the Water Quality Criteria Update for Ammonia (1999) that documents that fish are more sensitive to ammonia than are invertebrates

- An evaluation of bio-assessment results from North Carolina, Wyoming, Massachusetts, and Florida shows that a 26% reduction in the value of the biological metric, such as the number of species, relative to the value at a control site is a reliable measurement of impact to those species.

- The dose-response relationship shows that the number of fish species and the number of minnow species in Salt Creek will not decrease by more than 26% if the 30-day average ammonia concentration is not more than 2.1 mg/L based on summer results.

Manuscript 2 – Salt Creek *in Situ* Toxicity Testing Program

- Test species selection was based upon (1) the availability of an appropriate test methodology for application to Salt Creek, (2) acute and chronic sensitivity to ammonia (U.S. EPA 1998), and (3) species which could be cultured and available in suitable numbers and lifestages.

- An *in-situ* toxicity test was performed in which groups of caged fish (fathead minnows and channel catfish) were continuously exposed to ammonia for 30 days at nine locations in Salt Creek: Three "reference" sites upstream of both wastewater treatment plants, one site immediately upstream of the Northeast WWTP, and five sites downstream of the Northeast WWTP.

- The fathead minnows were unaffected, with the 30-day IC20 value above the highest in-stream total ammonia exposure concentration (> 9.98 mg-N/L).

- The 30-day IC20 total ammonia value for the channel catfish was 3.9 mg-N/L, which is the concentration of total ammonia that had a 20 percent effect on biomass (the combination of growth and survival).

- The *in-situ* results are "key" to determining a concentration of total ammonia, which will be protective of Salt Creek biological communities under chronic conditions.

Manuscript 3 – Salt Creek Ammonia Modeling

- Simulation modeling and regression modeling were conducted on Salt Creek to predict 30-day average (chronic) historic total ammonia concentrations in Salt Creek below the City's two wastewater treatment plants at corresponding bio-assessment Sites BSS04 (approximately 10,000 feet downstream of the Theresa St. WWTP) and BSS08 (approximately 4,600 feet downstream of the Northeast WWTP).

- Simulation modeling incorporated daily Salt Creek flows and daily wastewater treatment plant flows and ammonia concentrations for a six-year period. The modeling effort also incorporated an ammonia loss factor to account for ammonia changes over distance.

- The accuracy of the model to predict daily total ammonia concentrations was quantified by developing 95 percent confidence intervals. Confidence intervals for total ammonia at the two key biological sites were 1.55 mg N/L (BSS04) and 1.88 mg N/L (BSS08).

- The maximum 30-day average total ammonia concentration in Salt Creek, 180-days prior to each bio-assessment, at Sites BSS04 and BSS08, were selected for the derivation of bio-assessment–based site specific chronic ammonia criteria. The 30-day maximum average total ammonia values were 4.84 mg N/L and 5.62 mg N/L at Sites BSS04 and BSS08, respectively.

Manuscript 4 – Supplemental Laboratory Testing and Quality assurance/Quality Control

- In direct support of the *in-situ* testing program, laboratory testing was conducted to ensure that the data quality would be acceptable in a research/regulatory program of this type.

- Laboratory work included: (1) Extensive toxicity testing to determine the health of the test species and the sensitivity of different life stages to ammonia; (2) A comprehensive evaluation of key water quality parameters (e.g., ammonia, chloride, pH, DO); and (3) Analyses of pesticides and herbicides and Whole Effluent Toxicity (WET) testing to help evaluate whether other toxicants might have affected the study.

- The results of the laboratory work showed no anomalous results and strengthen the scientific defensibility of the *in-situ* program results.

Manuscript 5 – Data Integration and Site-Specific Ammonia Criteria Compliance

- A procedure using *in situ* study and bio-assessment results was developed to derive seasonal site-specific chronic total ammonia criteria that will be fully protective of the designated uses of Salt Creek Segment LP2-20000.

- *In situ* and bio-assessment study values for chronic total ammonia criteria were adjusted to account for summer and winter critical conditions with respect to pH and temperature following the EPA 1999 Ammonia Update and NDEQ guidance. Whole effluent toxicity testing results were also used to develop summer and winter chronic criteria.

- In developing site-specific chronic criteria for ammonia a weight-of-evidence approach is proposed that includes integrating extensive site-specific bio-assessment and *in situ* testing results in the context of the scientific recommendations of the water Environment Research Foundation Peer Review Panel.

- Proposed site-specific total ammonia chronic criteria are 2.1 mg N/L for summer and 5.4 mg N/L for winter based on an equal weighting approach between *in situ* and bio-assessment results.

- The City will comply with site-specific summer and winter chronic total ammonia criteria through a combination of end-of-pipe effluent limitations and Salt Creek in-stream compliance monitoring. This combined approach allows the City to use the assimilative capacity of Salt Creek and characterize Salt Creek on a daily basis. In the event of an end-of-pipe effluent limit exceedance, but with the Salt Creek in-stream total ammonia concentration below the criteria, no permit violation would occur.

Manuscript 6 – Regulatory Considerations

- The proposed water quality standard for Salt Creek segment LP2-20000 retains the aquatic life designated use of the Nebraska Surface Water Quality Standards, Title 117, established under the federal Clean Water Act.

- Proposed segment LP2-20000 site-specific implementing water quality standard aquatic life criteria for ammonia are the most appropriately protective of the resource based on meeting the provisions of Ch.4. §003.02A6b(4), "other scientifically defensible procedures" and EPA regulations and guidance including Water Quality Criteria; Notice of Availability; 1999 Update of Ambient Water Quality Criteria for Ammonia, 64 *FR* 71974, December 22, 1999, and the Salt Creek Water Quality Studies relating to early aquatic life-stage absence.

- The proposed site-specific criteria for ammonia reflect chemical, biological assessment, and Salt Creek Water Quality Studies toxicity data as a basis for assuring protection of the chemical, physical and biological integrity of the segment under §101(a) Clean Water Act, and EPA regulations and guidance including the EPA 1999 Notice and Update, WQ Criteria for Ammonia, the EPA Technical Support Document for Water Quality-based Toxics Control, 1991, and EPA 305(b) Guidelines for State Water Quality Assessments.

- The proposed winter seasonal criteria is based on the 1999 EPA Update of Water Quality Criteria for Ammonia because of the absence of early life-stages of fish in Salt Creek.

- Water quality criteria determination factors including magnitude, frequency, and duration of exposure such as flow, pH, and temperature are bases for the establishing site-specific aquatic life criteria, total maximum daily load wasteload allocations and NPDES permit requirements, under the Act, EPA Regulations at 40 C.F.R. Part 131 and 130, and EPA guidance including TSD for Water Quality-based Toxics Control. 1991.

- Compliance with water quality standards including as provided under NPDES permits is determined at the edge of the mixing zone for discharges to water bodies under EPA regulations at 40 C.F.R. Part 131, Nebraska Title 117, Ch. 2, §010, and EPA guidance including the EPA TSD, 1991.

- Water quality monitoring in water bodies is a method of assuring protection of the streams and assessing water quality standard compliance. *See*, EPA regulations including 40 C.F.R. Part 130 and EPA 305(b) Guidelines for State Water Quality Assessments.

The following is a more detailed summary of contents and results presented in each manuscript.

Manuscript 1 - The Response of Fish and Benthic Macroinvertebrates to Ammonia Toxicity in Salt Creek

From June 1994 through October 1999, six summer season and five winter season bio-assessments were conducted on Segment LP2-20000 of Salt Creek during the SCQWS. The technical objective was to characterize the condition of the biological community in Salt Creek and to identify some of the major limiting factors to the community using standardized scientific methods. Channelization, high ambient chloride concentrations, and effluent ammonia discharged from the City's two wastewater treatment plants (WWTP's) were identified as possible limiting factors.

Since 1998, the City has been evaluating ways to use bio-assessment results to derive, or to integrate into, site-specific ammonia criteria for Salt Creek. The WERF Peer Review Panel evaluated the defensibility of the bio-assessment methods and the data interpretation. From this, several recommendations were made to strengthen data interpretation including: evaluating the results of each bio-assessment separately; focusing the analysis on the summer collections when ammonia is most toxic; using biological metrics that demonstrate a dose-response relationship to pollution; and evaluating the results empirically.

An assessment of impairment to the biological community was completed that required an objective approach to determine change in the biological community. Diamond *et al.*

(*Evaluating Whole Effluent Toxicity Testing as an Indicator of In-stream Biological Condition, Water Environment Research Foundation, 1999*) evaluated the relationship between whole effluent toxicity (WET) test results and in-stream impairment. This study demonstrated that Relative Difference (RD) between upstream and downstream biological metric values was a reliable way to determine in-stream impact from WWTP discharges. For the evaluation of biological data collected from Salt Creek, an RD equal to 0.15, which equates to an approximate 26 percent reduction in the value of a biological metric value observed at the site-specific control station, was used as the threshold value for determining impairment at sites downstream of the City's two WWTP's. Biological data collected by the Nebraska Department of Environmental Quality (NDEQ) in eastern Nebraska were used to evaluate the sensitivity of metrics (number of fish species, number of native cyprinid (minnow) species, number of macroinvertebrate taxa, and number of chironomid taxa) to a gradient of human influence.

Protective total ammonia levels (total ammonia) were analyzed as the independent variable, and RD values were analyzed as the dependent variable in a linear regression for all the summer bio-assessment events. Total ammonia was expressed as the highest 30-day average total ammonia concentration observed 180 days prior to each bio-assessment. A site-specific, mass-balance simulation model of total ammonia concentrations in Salt Creek was used to estimate the 30-day average values. The highest protective total ammonia concentration is defined as the concentration associated with the point where the total ammonia/RD regression line intersects RD=0.15. No linear regression was needed for the macroinvertebrate data, since the RD values only indicated impact on two of 24 comparisons.

Final bio-assessment results is as follows:

> The dose response relationship shows that the number of fish species and the number of minnow species in Salt Creek will not decrease by more than 26 percent if the 30-day average ammonia concentration is not more than 2.1 mg N/L based on summer results.

Manuscript 2 - Salt Creek *in situ* Toxicity Testing Program

To more accurately characterize the complex interactions of ammonia in Salt Creek waters, an *in situ* toxicity test was performed in which caged fish were continuously exposed for 30-days at nine in-stream locations in Salt Creek. The *in situ* studies were conducted in the fall of 1999, with extensive preliminary research preceding this effort. The two selected fish species included fathead minnows (*Pimephales promelas*) and channel catfish (*Ictalurus punctatus*). This selection was based on their relative sensitivity to ammonia, the availability of experimental protocols, the ability to obtain sufficient numbers of experimental organisms, and their importance in the Salt Creek ecosystem.

The scientific goal of the *in situ* program was to calculate 30-day IC20 total ammonia values for fathead minnows and channel catfish, and use those data in combination with

other studies to determine a weight-of-evidence based site-specific chronic water quality criterion for total ammonia. It is important to recognize that the calculated IC20 values reflect the actual water quality conditions of Salt Creek during the 30-day exposure period (e.g. the in-stream variability of ammonia, pH, temperature, chloride, and other background water quality characteristics). Final *in situ* results are as follows:

- The 30-day IC20 total ammonia value for the channel catfish was calculated to be 3.85 mg N/L based on total biomass.

- The 30-day IC20 total ammonia values for the fathead minnow are greater than 9.98 mg N/L, because there was less than a 20 percent decrease in biomass at the downstream stations compared to the control.

Manuscript 3 - Salt Creek Ammonia Modeling

To predict historical and future Salt Creek total ammonia concentrations below the City's two WWTP's, two predictive tools were developed and compared: simulation modeling, based on a mass balance approach, and a regression model. The simulation model was selected as the model of choice to predict historical total ammonia concentrations prior to each Salt Creek bio-assessment at "key" locations in Salt Creek.

The simulation model was developed for the reach of Salt Creek from the Theresa Street WWTP to the end of the Northeast WWTP chronic mixing zone using approximately six years of daily Salt Creek flow and WWTP flow and total ammonia data. The model uses a simple mass-balance approach and an ammonia loss term, which incorporates temperature and travel time. For calibration purposes, comparisons between predicted values and actual Salt Creek measured total ammonia concentrations (based on historical sampling events) were made, which showed the model tended to under-predict total ammonia concentrations. To account for this bias, the model ammonia loss term was reduced. Using calibrated predicted values and actual measured values, confidence intervals around the predicted values were then developed.

Using the simulation model, maximum 30-day (chronic duration) average total ammonia concentrations within a 180-day period prior to each bio-assessment, as well as the average total ammonia 30-days immediately prior (antecedent) to each bio-assessment, were calculated at two Salt Creek biological sites. At biological Site BSS04 (below Theresa St. WWTP) the highest predicted maximum 30-day average and antecedent total ammonia values for all events were 4.84 mg/L and 3.44 mg/L, respectively. At biological Site BSS08 (below Northeast WWTP), the predicted values were 5.62 mg/L and 4.53 mg/L, respectively. These values were used in assessing chronic total ammonia criteria based on Salt Creek bio-assessment results, as discussed in Manuscript 1.

Both the simulation model and regression model could be used as a predictive tool to assess future daily Salt Creek total ammonia concentrations. As well, both could be used to determine allowable WWTP total ammonia concentrations to meet a target in-stream concentration. Based on the regression model's performance in predicting daily Salt

Creek total ammonia concentrations, and being an easier model to operate, it may be a more maintainable tool for City staff to use in management of future regulatory compliance efforts.

Manuscript 4 - Supplemental Laboratory Testing and Quality Assurance/ Quality Control

In direct support of the *in situ* testing program, extensive laboratory testing was conducted to ensure that data quality would be acceptable in a research/regulatory program of this type. The supplemental laboratory efforts included the following:

- Salinity tolerance testing of 30 to 45-day old fathead minnows and channel catfish.
- Salinity tolerance testing of < 24-hour old fathead minnow larvae.
- Test organism age study to quantify the sensitivity of < 24-hour old fathead minnows versus 30- to 45-day old fathead minnows to ammonia.
- Examination of the quality of test organisms using reference toxicant testing.
- Parallel chronic Whole Effluent Toxicity (WET) testing (during *in situ* program).
- An *in situ* salinity tolerance study using a series of control stations in several salinity zones (e.g., 1, 2, and 4 ppt, located upstream of the Theresa Street WWTP).
- Water quality monitoring of pesticides and herbicides at three in-stream locations at three different times during the in-situ program.
- Extensive sampling and testing for total ammonia, chlorides, conductivity, water temperature, pH, and dissolved oxygen was accomplished by the City at each *in situ* site during the 30-day testing period.

Laboratory test and quality assurance/quality control results were applied to various portions of the Salt Creek *in situ* test results and development of site-specific chronic total ammonia criteria.

Overall conclusions of the supplemental laboratory testing and quality assurance/quality control work are as follows:

- Growth of fathead minnow *juveniles* appears to be slightly reduced at higher salinities (e.g., 6 and 8 ppt); whereas *juvenile* channel catfish were unaffected at salinity concentrations as high as 10 ppt.

- With a 96-hr LC50 value of 3.8 ppt, *larval* Fathead minnows (<24 hrs old) were adversely affected at salinities normally expected in Salt Creek at moderately low flows. Survival in the 3.4 ppt ambient Salt Creek sample was 70 percent.

- The health of the juvenile fathead minnows and channel catfish used in the Salt Creek in-situ program appears to be acceptable based on laboratory reference toxicant testing.

- Acute and chronic WET testing of Theresa Street and Northeast WWTP effluents was conducted twice during the in-situ program.

- Chronic toxicity testing was conducted exposing *larval Ceriodaphnia dubia* and fathead minnows to Little Salt Creek water. The IC25 value for the minnows was >100 percent creek water, but the IC25 value for *C. dubia* was 27 percent Little Salt Creek water.

- Results from the pesticides and herbicides analysis did not indicate detected concentrations which would affect the toxicological results from the in-situ program.

Manuscript 5 - Data Integration and Site-Specific Criteria Compliance

The SCWQS generated a tremendous volume of site-specific chemical, physical, and biological data that define the overall ecological integrity of the aquatic ecosystem, and are directly applicable to the development and support of site-specific water quality criteria for ammonia. Consistent with guidance in U.S. EPA's (1991) Technical Support Document, the key components are:

- The results from chronic *in situ* testing using fathead minnows and channel catfish.

- Six summer and five winter bio-assessment studies of the fish and benthic macroinvertebrate communities.

- Acute and chronic toxicity testing of effluents from the City's WWTP's.

- Chemical monitoring of effluent and Salt Creek.

Because of the relative scientific strengths of each of these technical components, a weight-of-evidence approach is a valid mechanism for integrating these data to yield a single aquatic life criterion that will be protective of Salt Creek. As discussed above, the weight-of-evidence concept was presented to the WERF peer review team who fully agreed with the concept.

Table E-1 below presents the site-specific chronic criteria in a manner that allows them to be evaluated using the weight-of-evidence approach. The Table E-1 matrix makes the

summer and winter adjustment factors based on relationships in U.S. EPA's (1999) ammonia criteria update (currently proposed for incorporation into NDEQ Title 117 – Nebraska Surface Water Quality Standards). The format of the table is as follows: the type of study is presented down the left side (e.g., *in situ* results, bio-assessment results, WET); and the columns present the actual study values (and standard error) and the conversion of the study values into seasonal criteria values (summer and winter) based on the pH and temperature relationships presented in U.S. EPA's criteria documents (see detailed table footnotes).

Table E-1 Matrix of Site-Specific Ammonia Criteria Options Using EPA (1999) Ammonia Update for Seasonal Adjustment Factor

Criteria Source	Site-Specific Total Ammonia Chronic Criteria, mg N/L				
	Study Value	**Standard Error**	**Summer Season**	**Winter Season – Early Life Stage Present**	**Winter Season – Early Life Stage Absent**
In Situ					
In situ Channel Catfish w/ winter critical period defined as January	3.9	+/- 0.51	NA	NA	7.1[6]
In situ Channel Catfish w/ summer critical period defined as August	3.9	+/- 0.51	1.4[7]	NA	NA
In Situ – Fathead Minnow	>9.9[1]	NA	>3.6[7]	NA	>18.1[6]
In Situ – Fathead Minnow Adjusted for Sensitivity	>3.3[2]	NA	>1.2[7]	NA	>6.0[6]
Bio-assessment[3]					
Aquatic Community	2.1	NA	2.1[4]	NA	3.6[5]
Whole Effluent Toxicity[8]	6.7[9]		4.4[10]	13.2[10]	NA

[1]Based on highest exposure concentration (did not yield IC20 value). 30-day average value.
[2]Based on IC20 of >9.98/3.0 (from EPA 1999 criteria update; p. 70). Lab results may differ.
[3]Based on linear regression analysis with the threshold of impairment as Y = 0.15. Highest 30-day ammonia value, from simulation modeling, used to establish regression with metric relative difference.
[4]All collections were made during the summer season thus the study value equals the summer season.
[5]Winter – Winter value is based on multiplier as described in Footnote 6.
[6]Adjusted for winter condition assuming January is critical winter month. pH = 7.8 s.u. (median from City of Lincoln 1995 January Hydrolab data); Temperature = 3.8 Deg. C (75th percentile based on City of Lincoln 1995 January Hydrolab data). Multiplier = 1.81.
[7]Adjusted for summer condition assuming August is critical summer month. pH = 8.1 s.u. (median based on City of Lincoln 1995 August Hydrolab data); Temperature =25.5 Deg. C (75th percentile based on City of Lincoln 1995 August Hydrolab data). Multiplier = 0.36.
[8]Based on 7-day chronic WET testing for fathead minnows during *in situ* studies (9/26/99 – 10/10/99)
[9]Value is conservatively based on lowest IC_{20} value times lowest ammonia concentration from WET test samples.
[10]Seasonal values use EPA ammonia update (1999, p. 87) to convert WET test values (at pH/temp.) to NDEQ summer and winter pH/temperature values (8.1/27 and 7.9/7, respectively).

In developing a site-specific total ammonia criterion, the City proposes a weight-of-evidence approach that includes integrating site-specific bio-assessment and *in situ* testing results in the context of the scientific recommendation of the WERF Peer Review Panel. Results from WET testing performed on both the Theresa Street and Northeast WWTP's are used as corroborative evidence in support of the integrated criterion.

The City proposes that the results of the *in situ* tests and the bio-assessments be weighted equally in deriving the site-specific ammonia criteria for Salt Creek. An average of the two values is recommended.

Criteria = (bio-assessment value + *in situ* value)/2

As discussed in subsections above and shown in Table E-1, the current criteria correction for winter and summer would be based on the 1999 Ammonia Criteria document (EPA 1999), as proposed for NDEQ Title 117 – Nebraska Surface Water Quality Standards. It is also proposed that the ammonia criteria derived from bio-assessment be used as the lower bound or "floor" for the criteria calculation; meaning that the final Salt Creek site-specific criteria should not be less than the 2.1 mg N/L value which has been shown to be protective to the indigenous community. The resulting proposed values based on the current Title 117 language and the 1999 Ammonia Criteria Update, and use of the lower bound or "floor" value, are presented in Table E-2, below.

Table E-2 Proposed Chronic Site-Specific Total Ammonia Criteria (mg N/L) Based on Equal Weighting

	Summer	**Winter**
Criteria Based on EPA Ammonia Criteria Document 1999 Update		
Bio-assessment Value	2.1	3.8
In situ Value	1.4	7.1
Proposed Criteria	**2.1**[1]	**5.4**

[1]Lower bound or "floor" value based on criteria derived from bio-assessment.

The City will comply with the site-specific in-stream summer and winter chronic total ammonia criteria, as defined above, through a combination of end-of-pipe effluent limitation and Salt Creek in-stream compliance monitoring. This two-tiered approach would allow the City to monitor WWTP performance at the point of discharge but also would allow the City to characterize Salt Creek Segment LP2-20000 for total ammonia on potentially a daily basis. Measurement Point 1 for compliance purposes would be the Salt Creek in-stream measurement and its comparison to the site-specific criteria. Measurement Point 2 would be the end-of-pipe limit. Following this compliance approach, the City would not be in violation of their National Pollutant Discharge Elimination System (NPDES) permit total ammonia limitations if the effluent limit is exceeded but the corresponding Salt Creek in-stream concentration, at the point of compliance, does not exceed the chronic criterion.

Focusing site-specific chronic ammonia criteria compliance on actual Salt Creek conditions would allow the City to assess "real world" conditions in Salt Creek and not be restricted to conditions that may not realistically occur in Salt Creek. The following benefits would also be provided.

- Assesses actual long-term (chronic) conditions.
- Provides maximum Salt Creek watershed protection and continued comprehensive Salt Creek mainstem characterization for NDEQ and other agency benefit.
- Measures actual in-stream conditions and utilizes allowable assimilative capacity on a daily basis as a way to assess "true" aquatic life protection.
- Places the burden on the City of Lincoln to complete extensive daily monitoring and be accountable for in-stream conditions excluding upstream non-point source impacts.

This approach to NPDES permit compliance is very similar to that utilized by the South Dakota Department of Environment and Natural Resources for several municipal and industrial dischargers. These dischargers in State of South Dakota include: Rapid City, City of Mitchell, Bald Mountain-Lead Mining District, and the Richmond Hill mine.

Table E-3 shows chronic total ammonia effluent limits based on a wasteload allocation calculation and the proposed site-specific chronic criteria using an equal weighting (50/50 split), bioassessment alone and *in situ* alone. These proposed end-of-pipe permit limits follow NDEQs standard wasteload allocation (WLA) procedure, and do not include NDEQs second step, which converts the WLA into permit limits, and applies multiple safety factors. The approach of using the WLA values as permit limits is more appropriate for site-specific applications rather and does not warrant the application of unnecessary safety factors.

Table E-3 Comparison of Potential Chronic Ammonia Effluent Values Based on Various Site-Specific Ammonia Criteria

Scenario	Total Ammonia In-Stream Criteria, mg N/L	30Q5 Low-Flow, cfs (Upstream of Theresa St. WWTP)	Theresa Street WWTP Total Ammonia End-of-Pipe Permit Limit, mg N/L (Based on WLA)	Northeast WWTP Total Ammonia End-of-Pipe Permit Limit, mg N/L (Based on WLA)
Summer Season				
Site-Specific: Criteria Based **on Equal Weighting of Bio-assessment and i*n Situ* Study Values and 30Q5 Low-Flow**	2.1	56.1	5.5	17.6
Site-Specific: Criteria Based on **i*n Situ* Study Value Only and 30Q5 Low-Flow**	1.39	56.1	3.5	11.6
Site-Specific: Criteria Based on **Bio-assessment Study Value Only and 30Q5 Low-Flow**	2.1	56.1	5.5	17.6
Winter Season				
Site-Specific: Criteria Based on **Equal Weighting of Bio-assessment and i*n Situ* Study Values and 30Q5 Low-Flow**	5.4	64.1	15.2	23.9
Site-Specific: Criteria Based on **i*n Situ* Study Value Only and 30Q5 Low-Flow**	7.1	64.1	21.4	31.5
Site-Specific: Criteria Based on **Bio-Assessment Study Value Only and 30Q5 Low-Flow**	3.8	64.1	10.3	16.8

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